

# Study on the impact of trade openness on enterprise technological innovation: Based on the enterprise-level research in Jiangsu Province

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**Abstract:** *Based on the panel data of manufacturing enterprises in Jiangsu Province from 2003 to 2011, this paper empirically studies the impact of trade liberalization on technological innovation. Through research, it is found that the increased degree of trade liberalization can improve the production efficiency of enterprises through technology spillover and the expansion of raw material and intermediate goods market, but it also squeezes the market share of domestic enterprises, which may not be conducive to the research and development of new products, and this conclusion passes the robustness test. Through the heterogeneity analysis, it is found that trade openness has different impacts on technological R&D innovation of enterprises with different industry types and whether they have exports. It is concluded that we should actively promote the process of trade liberalization, constantly strengthen international cooperation, actively introduce foreign advanced technology and constantly improve the learning ability, so as to strengthen our own R & D and innovation ability.*

**Keywords:** *trade liberalization, enterprise technological innovation, development*

## 1. Introduction

With the deepening development of economic globalization, more and more countries and regions are actively implementing the policy of promoting trade opening-up and increasing the degree of trade liberalization. And this trend of international trade development has also been widely concerned by the academic community. Reviewing the process of China's opening to the outside world, we can find that the process of China's opening to the outside world is from a partial to the whole, low to high process, first choose the eastern region as a pilot window, and then continue to expand the scope of opening up. After joining the WTO, China has further deepened the opening to the outside world, and continuously promoted the process of trade liberalization through the policy of tariff reduction, which is manifested as our initiative to adapt to and integrate into the international economic and trade system. Although the degree of trade liberalization at this time was greatly improved, it was still asymmetrical opening to the outside world, mainly for developed countries. After the financial crisis, due to the imbalance of the international division of labor in the past, developed countries began to actively promote the return of manufacturing, while China also took a more positive attitude to expand the depth and breadth of opening up, actively strengthen economic and trade exchanges with developing countries, and implement more proactive opening up policies such as "One Belt, One Road". Studies on the economic effects of promoting trade opening are also increasingly abundant. Scholars have found that international trade can also ease corporate financing constraints by increasing corporate profits, laying a foundation for enterprises to increase R&D investment. Through the improvement of trade liberalization, enterprises in the importing country can obtain intermediate products more conveniently, thus triggering fierce competition in the domestic intermediate goods market of the importing country. In this way, industries in the importing sector can carry out production activities at a lower cost, and the integration with domestic production factors can also improve production efficiency to a certain extent, thus reducing costs and increasing output. Bring the increase of business profits. Trade exchanges between China and other countries to learn advanced technology and management experience, which lays the foundation for the rapid economic development of our country, is conducive to the strengthening of our international competitiveness.

With the entry of the information age, the importance of scientific and technological innovation has become increasingly prominent, and technological progress has become an important source of a country's rapid economic growth, but also an important factor in achieving sustainable development.

Whether promoting trade liberalization will affect the technological innovation of the importing country has become a hot issue of academic concern. At the same time, the global economy is also facing the impact of trade protectionism and unilateralism, and China is facing increased uncertainty in the external environment. The process of trade liberalization may be affected, which in turn will affect the business activities of our enterprises. Therefore, it is increasingly important to study trade liberalization and technological progress of enterprises. In this paper, Jiangsu Province is chosen as the research object, because Jiangsu Province's foreign trade is relatively developed, and the conclusion is more convincing. In the face of the deepening development of globalization, promoting technological innovation of enterprises by means of trade liberalization is of great significance to forming a good development foundation for the manufacturing industry in Jiangsu Province, and also plays an extremely important role in improving the international competitiveness of enterprises in Jiangsu Province.

## 2. Literature review

The technology gap of international trade was first proposed by the advocates of the new trade theory school. They regard technology as an element of production, and believe that countries with technology gap may conduct international trade, and developed countries with high technology level may transfer technology to countries and regions with low technology through technology transfer. Countries with backward technological level can realize technological progress through technology introduction, imitation and independent innovation. And the technological gap between different countries may continue to narrow through international trade. In addition, technologically backward developing countries have a certain technology absorption capacity, and technologically backward countries have a stronger willingness to strengthen technical cooperation with developed countries, while international trade provides the basis for technology diffusion, and promotes technology diffusion through product trade.

Moreover, through the research, it is found that promoting trade opening can promote domestic and foreign enterprises to strengthen economic cooperation, especially in technologically advanced countries and technologically backward countries to achieve trade opening. Faced with fierce market competition, enterprises will inevitably strengthen technological input, improve technological level by introducing advanced technology or increasing R&D investment, and thus enhance competitive advantage. And consumers will also tend to choose better quality, more advanced technical level of products, enterprises only in order to win the favor of consumers to meet the market demand, in order to avoid being eliminated in the fierce market competition. Based on the data of Chinese manufacturing enterprises as research samples, domestic scholars found that the import tariff reduction policy is conducive to the productivity improvement of manufacturing enterprises, especially the import tariff reduction of intermediate goods, which can optimize the allocation of manufacturing enterprises. The intensified competition in the intermediate goods market can enable domestic enterprises to use high-quality and cheap intermediate goods, thus improving the efficiency of market resource allocation. Thus improve the production efficiency of enterprises. In addition, promoting the process of trade liberalization may reduce industry profits to a certain extent, but improve market vitality, which is conducive to industrial development in the long run.

However, opponents also found from the data that international trade instead makes the importing country fall into the trap of low-end locking, making its industrial structure at the lower end of the value chain. Generally speaking, due to the reduction of tariffs, enterprises can reduce the cost of introducing foreign advanced technology and equipment, and improve the availability of high-quality intermediate products. The importing country obtains the products through international trade, and then absorbs and transforms the advanced technology of its meaning, which can promote its own research and development ability, thus improving the speed and level of enterprise innovation. However, the learning and absorption of technology also depends on the corresponding supporting facilities and human capital, and has a certain threshold. This may also explain the dampening effect of international trade on technological progress. In addition, developed countries with higher technology levels may reduce the technology diffusion effect brought about by national trade through measures such as limiting the outflow of core technologies. Therefore, international trade may not have a positive impact on both sides of the trade. If one party engaged in trade has the position of technology monopoly and occupies a dominant position in international trade, it may strengthen the control over technology export, and countries or regions with technology monopoly can increase trade and obtain high profits, and inhibit the development of related industries in technologically backward countries. Widen the technological gap between the two industries. In addition, as technologically backward countries promote the upgrading of industrial structure and realize technological progress by means of technology introduction and imitation

innovation, they will be affected by their own human capital level and other factors, thus limiting the speed and expected effect of technology diffusion. Some scholars also pointed out that the technological backward international or regional industrial development level is low, and promoting the process of trade liberalization by slashing tariffs may worsen the external environment for industrial development, and even inhibit the technological progress of enterprises.

Domestic and foreign scholars have conducted extensive studies on trade openness and technological progress of enterprises. The earliest definition of technological innovation is that production factors are not combined, so as to form more competitive enterprises with new technologies. With the improvement of trade liberalization, technology spillover can be conducive to rapid economic growth, but there are also some concerns, that is, whether the international division of labor brought by trade opening will lead to the low-end technology lock in developing countries, or achieve technological upgrading through market competition.

In his research on the relationship between trade liberalization and technological progress of developing countries, Li Jianwei (2010) found that international trade of tangible or intangible products would bring about technological diffusion, and pointed out that developing countries should actively participate in economic globalization and promote technological progress of developing countries with the help of trade liberalization.<sup>[1]</sup> Zhou Fengxiu et al. (2017) discussed the impact of trade liberalization on the innovation ability of enterprises from the perspective of financing constraints, and found that financing constraints are the key factors restricting the improvement of trade openness on the innovation ability of enterprises, and proposed to create a good financing environment so as to give full play to the ability of trade liberalization to improve the innovation effect of enterprises.<sup>[2]</sup> Some scholars have discussed the economic effects of trade opening from the perspective of tariff concessions,<sup>[3]</sup> and found that there is a threshold effect on the impact of tariff concessions on the improvement of enterprises' R&D efficiency. When the tariff concessions are lower than the threshold value, the degree of trade opening has the greatest effect on the improvement of enterprises' R&D innovation efficiency; however, when the tariff concessions are higher than the threshold value, the effect of trade opening on the improvement of enterprises' R&D innovation efficiency is greater. Its positive impact on the innovation efficiency of enterprises will show a weakening trend. The possible explanation for this is that when the degree of tariff concession is too low, the industry will be greatly impacted, but the positive economic effect brought by trade opening cannot motivate enterprises to invest in research and development. Cui Jinghua et al. (2021) found in their study on the effect of tariff concessions on technological innovation in the manufacturing industry on intermediate goods and final goods, that the impact of tariff concessions on technological innovation in the intermediate goods and final goods markets is significantly different, and specific analysis should be carried out based on specific situations to better exert the effect of technological innovation brought about by trade opening.<sup>[4]</sup>

Some scholars have studied the influence mechanism of trade liberalization on technological innovation from the perspective of intermediate goods market and service industry. From the research of trade liberalization in intermediate goods market, it is found that trade liberalization in intermediate goods market can significantly promote the improvement of production efficiency of enterprises, and can strengthen the external effect of economic agglomeration on the improvement of production efficiency of enterprises. It also points out that a perfect business environment can improve the spillover effect of technology. Moreover, through the heterogeneity analysis, it is found that the technological innovation capability of enterprises with different firm sizes, capital intensive or labor intensive degrees is different from the impact of trade liberalization in the intermediate goods market.<sup>[5]</sup> With the increasingly prominent importance of the service industry, many scholars have focused on the research on whether liberalization of trade in the service industry can promote technological innovation of enterprises. Some scholars have pointed out that trade liberalization can stimulate enterprises to improve innovation ability through technology transfer and diffusion, economies of scale and market competition. The detailed research on whether the liberalization of service trade can improve the innovation ability of enterprises in different industries is of great significance for in-depth exploration of trade openness and technological progress. Based on the relevant data of Chinese industrial enterprises, the empirical study also found that service trade liberalization is an effective way to improve the innovation ability of enterprises. In addition, some economists put the research perspective on the impact of trade openness on enterprise innovation mode, dividing enterprise innovation mode into product innovation and process innovation, and discussing the effect of trade liberalization degree on enterprises' choice of innovation mode. Scholars believe that some enterprises in China's manufacturing industry may be in danger of falling into the low-end lock of the global value chain, and how to change the low value-added of enterprises' products, the key is to improve the innovation ability of enterprises and realize the climb of the value chain. Through the study on the enterprise innovation mode of trade opening, it is found that the import of intermediate

goods is conducive to the realization of high-end innovation of Chinese products, and the liberalization of intermediate goods trade is conducive to the improvement of operating profits of enterprises and further promote the expansion of export scale. Moreover, through the study from the perspective of enterprise innovation mode, it is found that the stronger the absorption capacity of enterprises, the more technology spillover effect can be improved. At this time, enterprises are more inclined to engage in high-end innovation.<sup>[6]</sup> Zhao Can et al. (2019), based on the impact of China's opening up from the stage of adapting to international trade rules to leading the trend from 2001 to 2016 on the opening up to the outside world and the innovation ability of enterprises, found that in the stage of joining the international trade Organization, intra-industry trade liberalization and upstream trade liberalization will significantly promote the innovation of enterprises.<sup>[7]</sup> On the contrary, the increased openness of downstream trade will inhibit enterprise innovation. However, with the deepening of opening to the outside world, intra-industry trade liberalization will inhibit enterprise innovation, while upstream and downstream trade liberalization can promote the improvement of enterprise innovation ability. Economists attribute this change to the following reasons: As intra-industry trade liberalization increases, a large number of foreign products enter the industry, thereby squeezing the market share of domestic enterprises. As a result, the profits of enterprises are significantly reduced, and the cost of R&D investment of enterprises is increased due to the decrease of market share.<sup>[8]</sup> Although enterprises are forced to develop new products to maintain competitive advantages in the fierce market competition, it is difficult for enterprises to effectively carry out innovation activities under financing constraints and market competition pressure.<sup>[9]</sup>

In addition, some economists believe that there is a threshold effect between the degree of trade liberalization and the technological progress of enterprises in R&D. This scholar believes that the relationship between the degree of trade liberalization and the technological progress of enterprises in R&D is not linear, but with the continuous growth of the degree of trade liberalization from low to high, the technological level of R&D will show a trend of improvement. However, increasing trade liberalization may inhibit the level of research and development technology. In addition, scholars have found that the effect between the two will also be affected by factors such as the degree of marketization, different industry types and the level of R&D of enterprises. Some scholars study the impact of trade openness on the innovation ability of manufacturing enterprises from the perspective of human capital. They believe that the improvement of trade liberalization can bring technology spillover, but if the gap between the two is too large, it may reduce the promotion effect of trade liberalization on the technological progress of enterprises.<sup>[10]</sup> In order to improve the absorption capacity of enterprises, so as to strengthen the role of international trade exchanges in promoting technological progress of enterprises.

### 3. Model construction and data sources

#### 3.1. Data source

In this paper, the panel data of the manufacturing industry in Jiangsu Province from 2003 to 2011 are selected, and the data at the enterprise and industry level are from the China Industrial Enterprise Database and the China Statistical Yearbook. The setting of specific variables is as follows:

The explained variable is the innovation capability of the enterprise, which is represented by the total output value of the enterprise's new product in this paper and represents the effect of the transformation of the enterprise's R&D investment, that is, the R&D innovation capability of the enterprise. In order to ensure the rigor of the empirical results, the OL method of Lian Yujun is used to make an empirical analysis of the total factor productivity and R&D investment of enterprises. The core explanatory variable of this paper is trade openness, and the ratio of the total import and export volume of an industry to the total industrial output value of the industry is expressed by referring to the general practice and data availability of the academic circle and the practice of relevant scholars. Other control variables include control variables mainly at the enterprise, industry and province levels, including the degree of industry competition (HHH  $i$ ), which is represented by the Herfindahl index; The proportion of non-state-owned enterprises in an industry (market) is expressed by the proportion of the total industrial output value of non-state-owned enterprises in the total industrial output value of different industries. Firm level control variables, including firm age, were obtained by subtracting the year of establishment of the firm. The export scale of the enterprise is represented by the logarithm of the total export; Enterprise size (size), using the logarithm of the total industrial output value; Business interest expense (loan).

### 3.2. Model setting

In order to investigate the impact of the degree of trade liberalization on technological progress, this paper constructs an econometric model, which is set as follows:

$$y_{ijt} = \alpha_0 + \alpha_1 trade_{jt} + \mu X_{it} + \gamma_i + \gamma_j + \gamma_t + \varepsilon_{ijt}$$

Where, subscripts  $i$ ,  $j$  and  $t$  represent enterprise, industry and year respectively,  $y_{ijt}$  represents the innovation and research and development level of enterprise  $i$  in industry  $j$  in year  $t$ , while  $trade_{jt}$  represents the degree of trade liberalization of industry  $j$  in year  $t$ , and is represented by logarithm.  $X_{it}$  indicates the control variables at the industry level, including the degree of industry competition, marketization level, export scale, enterprise age and enterprise scale.

## 4. Empirical results

### 4.1. Baseline regression results

The benchmark regression results of this paper are shown in Table 1. The explained variable in column (1) is the output value of new products, and the industry-level control variables are added in column (2) on the basis of column (1). The results show that the estimated coefficient of trade liberalization is significantly negative, indicating that there is a negative correlation between trade liberalization and the output value of new products. The possible reason is that the opening of trade squeezes the market share of domestic enterprises, and it is difficult for enterprises to invest resources for new product research and development under the pressure of fierce market competition. From the estimation results of other control variables, the estimated coefficients of enterprise export volume and enterprise scale are significantly positive, which indicates that the larger the export volume and enterprise scale, the higher the risk resistance of enterprise innovation may be, and the more favorable it is for enterprises to conduct new product research and development. Columns (3) and (4) in Table 1 are replaced by explanatory variables as total factor productivity of enterprises, and the estimated coefficient of trade liberalization is significantly positive, indicating that trade liberalization is conducive to the improvement of enterprise productivity. The possible reason is that the increased degree of trade liberalization makes it easier for domestic enterprises to introduce technology and access the intermediate goods market, thus reducing costs and improving efficiency. According to the estimated results of the control variables, the coefficient between enterprise scale and industry competition degree is significantly positive, indicating that the larger the enterprise scale, the fiercer the industry competition, and the more incentive enterprises can improve production efficiency. However, the estimated coefficient of the export scale of enterprises is significantly not negative, which may be related to the export enterprises of processing trade. The estimated coefficient of corporate interest expense is also negative, indicating that corporate debt is not conducive to productivity improvement.

Table 1: Results of baseline regression

	(1) <i>new product</i>	(2) <i>new product</i>	(3) <i>TFP</i>	(4) <i>TFP</i>
<i>trade</i>	-0.347*** (-3.80)	-0.346*** (-3.78)	0.379*** (6.87)	0.394*** (7.14)
<i>age</i>	0.603 (1.08)	0.606 (1.08)	-8.971*** (-26.56)	-8.943*** (-26.49)
<i>expv</i>	0.579*** (6.34)	0.579*** (6.34)	-0.775*** (-14.10)	-0.772*** (-14.05)
<i>size</i>	0.030*** (8.51)	0.030*** (8.53)	0.732*** (346.10)	0.732*** (346.42)
<i>loan</i>	-0.048 (-0.50)	-0.048 (-0.50)	-1.074*** (-18.34)	-1.074*** (-18.35)
<i>HHi</i>		0.237 (0.69)		2.331*** (11.31)
<i>market</i>		-0.023*** (-6.00)		-0.141*** (-61.82)
<i>_cons</i>	-0.244*** (-2.74)	-0.077 (-0.86)	-1.712*** (-31.84)	-0.648*** (-11.91)
<i>N</i>	228276	228276	227402	227402
<i>R<sup>2</sup></i>	0.453	0.453	0.871	0.871

#### 4.2. Robustness test

In order to eliminate the problem of possible selection bias in variables and samples, a robustness test is required. In this paper, the core explanatory variables lag one stage for regression analysis. The test regression results are shown in columns (1) and (2) of Table 2 below. It is found that when the explained variable is the output value of new products, the conclusion does not change substantially, while when the explained variable is enterprise productivity, the estimated coefficient is negative, indicating that over-reliance on imported technology and imitation is not conducive to long-term improvement of enterprise production efficiency.

Table 2: Estimated results of robustness test

	(1) <i>new product</i>	(2) <i>TFP</i>	(3) <i>labor</i>	(4) <i>capital</i>	(5) <i>technology</i>
<i>trade</i>			1.459*** (3.89)	-0.024 (-0.21)	0.503*** (7.09)
<i>L. trade</i>	-0.248*** (-4.12)	-0.057* (-1.77)			
<i>Controls</i>	YES	YES	YES	YES	YES
<i>N</i>	146924	146573	86360	94933	46109
<i>R<sup>2</sup></i>	0.457	0.871	0.851	0.877	0.884

#### 4.3. Heterogeneity analysis

According to the heterogeneity analysis by industry type, the regression results are shown in columns (3) - (5) of Table 2. For labor-intensive and technology-intensive industries, the estimated coefficient of trade liberalization is significantly positive, and the estimated coefficient of trade liberalization for labor-intensive industries is larger, which indicates that trade liberalization has a greater effect on the productivity improvement of enterprises in labor-intensive industries. According to whether the enterprises are exporting, the regression results are grouped according to whether the enterprises are exporting. The regression results are shown in columns (1) - (2) of Table 3. For total factor productivity as the explained variable, trade liberalization has a stronger effect on the productivity improvement of exporting enterprises.

Table 3: Results of heterogeneity analysis

	(1) <i>export enterprise</i>	(2) <i>Non – export enterprise</i>
<i>trade</i>	0.268*** (4.21)	0.315*** (2.60)
<i>Controls</i>	YES	YES
<i>N</i>	190580	36822
<i>R<sup>2</sup></i>	0.875	0.906

#### 5. Conclusion

Through an empirical analysis of the data of manufacturing enterprises in Jiangsu Province from 2000 to 2013, this paper finds that industrial trade liberalization has a significant promoting effect on R & D innovation ability. Moreover, through heterogeneity analysis, it is found that the technology spillover effect brought by trade liberalization is more significant for capital-intensive and technology-intensive industries. In this regard, I draw the following suggestions:

First, by continuously improving the level of technology stock, we will continuously narrow the technological gap with developed countries. In the face of the increasingly complex international economic environment, especially with the emergence of trade protectionism and unilateralism, we must establish a correct concept, open up to the outside world with a more proactive attitude, optimize the allocation of resources through participation in the international industrial chain, and learn advanced management experience and successful experience through international trade. Second, it is necessary to make clear that technological innovation plays an important role in China's high-quality economic development, and technological innovation is an important driving force for economic growth. We should actively guide trade opening and promote enterprise technological innovation. We should also strengthen

international trade cooperation, promote regional trade agreement negotiations, encourage enterprises to improve enterprise production efficiency in the fierce market competition, and actively improve enterprise absorption capacity. Therefore, the positive impact of trade liberalization on innovation and research and development ability is strengthened, and the international competitiveness of enterprises is improved. Third, it is necessary to continue to fully understand the mechanism of trade liberalization's impact on innovation and R&D capacity. On the one hand, with the improvement of the degree of trade liberalization in the industry, although it will have a positive impact on the innovation ability of enterprises by promoting the optimization of resource allocation efficiency in the industry, technology spillover, improving the profitability level of the industry and strengthening the degree of market competition, if it is an emerging industry or in the low-end link of the global value chain, the degree of trade liberalization may inhibit the technological progress of the industry, but may not be conducive to the healthy development of the industry. Therefore, in the process of promoting opening-up, we should look at the objective laws of industrial development more scientifically and rationally, so as to better play the positive role of trade liberalization in technological progress.

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